



[7590-01-P]

## **NUCLEAR REGULATORY COMMISSION**

**[Docket No. 50-423; NRC-2012-0197]**

**Dominion Nuclear Connecticut, Inc.**

**Millstone Power Station, Unit 3**

### **Exemption**

#### **1.0 BACKGROUND**

Dominion Nuclear Connecticut, Inc., (the licensee, Dominion) is the holder of Renewed Facility Operating License No. NPF-49, which authorizes operation of the Millstone Power Station, Unit 3 (MPS3). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

MPS3 shares the site with Millstone Power Station Unit 1, a permanently defueled boiling water reactor nuclear unit, and Millstone Power Station Unit 2, a pressurized water reactor. The facility is located in Waterford, Connecticut, approximately 3.2 miles west southwest of New London, CT. This exemption applies to MPS3 only. The other units, Units 1 and 2, are not part of this exemption.

#### **2.0 REQUEST/ACTION**

Section 50.46 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," requires that each power reactor meet the acceptance criteria for ECCS provided therein for zircaloy or ZIRLO™ cladding. Appendix K of 10 CFR Part 50, "ECCS Evaluation Models," requires the rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction to be calculated using the Baker-Just equation (Baker, L., Just, L.C.,

“Studies of Metal Water Reactions at High Temperatures, III. Experimental and Theoretical Studies of the Zirconium-Water Reaction,” ANL-6548, page 7, May 1962).

Both of the above requirements require the use of zircaloy or ZIRLO™ cladding. The licensee proposes to use Optimized ZIRLO™ as the cladding material and therefore is requesting an exemption from the requirements.

In summary, by letter dated November 17, 2011, (Agencywide Documents Access and Management System (ADAMS), Accession No. ML11329A003), the licensee requested an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50. The reason for the exemption is to allow the use of Optimized ZIRLO™ as a cladding material.

### 3.0 DISCUSSION

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. These circumstances include the special circumstances that application of the regulation is not necessary to achieve the underlying purpose of the rule.

#### Authorized by Law

This exemption would allow the licensee to use Optimized ZIRLO™ fuel rod cladding material at MPS3. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50. The NRC staff has determined that granting of the licensee’s proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission’s regulations. Therefore, the exemption is authorized by law.

#### No Undue Risk to Public Health and Safety

The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for adequate ECCS performance. By letter dated June 10, 2005 (ADAMS Accession No. ML051670408), the

NRC staff issued a safety evaluation (SE) approving Addendum 1 to Westinghouse Topical Report WCAP-12610-P-A and CENPD-404-P-A, "Optimized ZIRLO™" (ADAMS Accession No. ML062080576), wherein the NRC staff approved the use of Optimized ZIRLO™ as a fuel cladding material. The NRC staff approved the use of Optimized ZIRLO™ as a fuel cladding material based on: (1) similarities with ZIRLO™, (2) demonstrated material performance, and (3) a commitment to provide irradiated data and validate fuel performance models ahead of burnups achieved in batch application. The NRC staff's SE for Optimized ZIRLO™ includes 10 conditions and limitations for its use. As previously documented in the NRC staff's review of topical reports submitted by Westinghouse Electric Company, LLC (Westinghouse), and subject to compliance with the specific conditions of approval established therein, the NRC staff finds that the applicability of these ECCS acceptance criteria to Optimized ZIRLO™ has been demonstrated by Westinghouse. Ring compression tests performed by Westinghouse on Optimized ZIRLO™ (NRC reviewed, approved, and documented in Appendix B of WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™") (ADAMS Accession No. ML062080576) demonstrate an acceptable retention of post-quench ductility up to 10 CFR 50.46 limits of 2200° Fahrenheit and 17 percent equivalent clad reacted. Furthermore, the NRC staff has concluded that oxidation measurements provided by the licensee illustrate that oxide thickness (and associated hydrogen pickup) for Optimized ZIRLO™ at any given burnup would be less than both zircaloy-4 and ZIRLO™. Hence, the NRC staff concludes that Optimized ZIRLO™ would be expected to maintain better post-quench ductility than ZIRLO™. This finding is further supported by an ongoing loss-of-coolant accident (LOCA) research program at Argonne National Laboratory, which has identified a strong correlation between cladding hydrogen content (due to in-service corrosion) and post-quench ductility.

The underlying purpose of 10 CFR Part 50, Appendix K, Section I.A.5, "Metal-Water Reaction Rate," is to ensure that cladding oxidation and hydrogen generation are appropriately

limited during a LOCA and conservatively accounted for in the ECCS evaluation model. Appendix K states that the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of the rule would not permit use of the equation for Optimized ZIRLO™ cladding for determining acceptable fuel performance. However, the NRC staff has found that metal-water reaction tests performed by Westinghouse on Optimized ZIRLO™ demonstrate conservative reaction rates relative to the Baker-Just equation and are bounded by those approved for ZIRLO™ under anticipated operational occurrences and postulated accidents.

Based on the above, no new accident precursors are created by using Optimized ZIRLO™, thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. Therefore, there is no undue risk to public health and safety.

#### Consistent with Common Defense and Security

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material at MPS3. This change to the plant configuration has no relation to security issues. Therefore, the common defense and security is not impacted by this exemption.

#### Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 is to establish acceptance criteria for ECCS performance and to ensure that cladding oxidation and hydrogen generation are appropriately limited during a LOCA and conservatively accounted for in the ECCS evaluation model. The wording of the regulations in 10 CFR 50.46 and Appendix K is not directly applicable to Optimized ZIRLO™, even though the

evaluations above show that the intent of the regulation is met. Therefore, since the underlying purposes of 10 CFR 50.46 and Appendix K are achieved through the use of Optimized ZIRLO™ fuel rod cladding material, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from certain requirements of 10 CFR 50.46 and Appendix K exist.

#### 4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants Dominion an exemption from certain requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50, to allow the use of Optimized ZIRLO™ fuel rod cladding material, for MPS3.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (77 FR 50533).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 23<sup>rd</sup> day of August 2012.

FOR THE NUCLEAR REGULATORY COMMISSION

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